that such works as the present are calculated not to create Biologists, but to perpetuate a race of mere collectors and labellers—men whose highest aim is to gather "new" or "rare" species; who spend their holidays in accumulating *specimens*, sending those that are unfamiliar across the Channel for identification or naming. One of the results of the latter procedure is that the present work contains no less than 200 British species or varieties bearing Nylander's name as the author of their first description!

While, however, meagre attention has been thus bestowed upon the secondary reproductive organs, undue prominence is given to the action of potash and lime on the thallus and apothecia, and the reaction of iodine with the hymenial gelatine; phenomena that are so uncertain and inconstant that they vary even in the same individual under different circumstances. We would not *exclude* chemical or *any* natural characters from the definition of species; but the present work seems to us to furnish ample illustration of the danger of making use of secondary, trivial, inconstant characters as a basis for classification (*e.g.* the genus *Cladonia.*)

The localities of growth are satisfactory so far as they go; but they are utterly inadequate as representing the distribution of species in either of the three kingdoms. In order to specify, with at all adequate fulness, the diversity of locality occupied in England, Scotland, and Ireland respectively by the species enumerated, Mr. Leighton must have examined for himself the contents of all the Lichen-Herbaria in these kingdoms; and, though the said herbaria are neither numerous nor large, compared with those of flowering plants, such a labour is obviously impossible for any *one* man of average leisure and opportunities.

There is no Tabular Summary showing the numerical richness of the British Lichen-Flora; an omission, it may be, of minor importance, but still of importance, inasmuch as it is always interesting to "take stock" occasionally of the rate of progress of the additions that are being made to a national Sub-Flora. Basing our calculations on the data supplied by the present work, we find a total of 73 genera and no less than 781 species; whereas only last year in his enumeration, Crombie (p. 124), gave the whole number of British Lichens then known as 658, the difference apparently representing, or consisting of, so-called *new* species. Of the host of these *new* species added of late years to our Lichen-Flora, perhaps not above one-fifth will survive in that "struggle for existence," to which they will sooner or later have to submit at the hands of the philosophic botanist. A large proportion will doubtless be found to consist of *mere forms of common, protean, widely distributed species*—forms that neither require nor deserve separate nomenclature and rank.

We have not exhausted the list of blemishes in the book before us. But to notice *all* the errors in matters of detail; all those points on which other lichenologists are likely to take grave exception to his views; all the faults in typography or otherwise, would extend and expand this review into a Treatise on the Classification of Lichens; for it would necessarily deal with certain features of that Nylanderian system, which Mr. Leighton follows in his present work.

With all the aids the author gives the student, it will, we fear, be impossible for the latter to identify the majority of the less common and familiar species without reference to authentic specimens named by Mr. Leighton himself. The work is so elaborate and complex, the principles and practice of classification adopted in it are so puzzling, that we candidly confess our own general impression to be one of increasing bewilderment, and of growing indisposition to attempt the identification or nomenclature of Lichens at all! We hesitate not to avow our own preference for studies on the Biology of the common economical species, such as those which *at present* are called *Cladonia rangiferina*, *Usnea barbata*, *Ramalina calicaris*, *Parmelia saxatilis*, *Roccella tinctoria*, or *Lecanora tartarea.*

On the whole, however, the "Lichen-Flora of Great Britain" is a work that should find a place in every public botanical library in the three kingdoms, as well as in the private libraries of all students of the extremely puzzling cryptogamic family of which it treats.

W. LAUDER LINDSAY

## OUR BOOK SHELF

*A Complete Course of Problems in Practical and Plane Geometry, adapted for the Use of Students preparing for the Examinations, &c.* By John William Palliser, Second Master and Lecturer of the Leeds School of Art and Science. (London: Simpkin and Marshall.)

A NEW class-book on Practical Geometry commends itself to our attention. Mr. John Palliser, of the Leeds School of Art and Science, has produced one of those educational works which a demand created by Government examinations has recently brought to our aid. Reserving our opinion as to the final tendency of an epidemic for what are called practical results, we must, in justice, say that this class-book of Mr. Palliser's is the very thing for cheapness, conciseness, comprehensiveness, to rapidly possess the student with a ready-handed ability to answer all demands of the examiner. The work is not encumbered with demonstration, for this, in view of the proposed end, would be out of place; it is a laboratory of experimental formulæ. We have a recipe for constructing all conceivable polygons within the compass of a single circle, for drawing lines to invisible points, and for trisecting the most obdurate angles by the magic of a slip of paper. Faith is all that is demanded of the student, faith in the formulæ before him, and industry to get them by heart. Not troubled with the Why, he has only to remember the How; but he must be careful, exact, and neat-handed; and this, if not mental training, is next of kin to it. The arrangement of the book is generally good, the style concise in the extreme, the letter-press wonderful at the price, and the diagrams, with their faint, dark, or dotted lines, are highly effective and intelligible, not less so from the fact of the *lettering* being (what we very seldom find it) correct.

To examine in detail the 220 problems of Mr. Palliser's book is more than we can just now undertake; but so far as we have dipt into them there is little to complain of, considering that the work is merely practical. The style, we have said, is concise; but (if we might venture a criticism on a point where most geometers are more guilty than Mr. Palliser) it would lose nothing in intelligibility if the nominative case were less frequently preceded by a multitude of perplexing conditions which really have to be neglected by the learner till the said nominative is reached, and then returned to lastly in that natural order of thought which geometers have a fancy for inverting. Whilst taking these minor exceptions, we must not omit to call the author's serious attention to Problem 13, which, whether we consult the diagram or the letter-press, is wholly fallacious. Such a construction will not effect the

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object of the problem, the bisection of the angle, though the line H K will converge in common with the two given lines. We must further enter protest against the *unqualified* proposal "to draw a straight line equal to the true length of the circumference of a circle" (Prob. 184) as misleading to the learner. But, any such defects notwithstanding, here is a most wonderful eighteenpenny book.

## *LETTERS TO THE EDITOR*

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

### Geometry at Oxford

In the last number of NATURE Mr. Proctor remarks that "no one who considers carefully the mathematical course at either University, can believe that it tends either to form geometricians or to foster geometrical taste."

With regard to Oxford, I think it is only fair that some qualification should be offered to this conclusion. In Cambridge, candidates for mathematical honours have to run their race in a course clearly marked out for them, and loss of place is naturally the result of individual vagaries. But in Oxford the order of merit is not carried further than distribution into classes, and I do not believe there is anything to prevent a skilful geometrician finding himself in the first class with those who put their trust most in analytical methods.

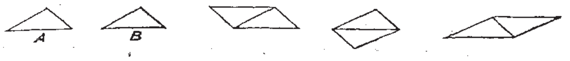
I cannot pretend to much geometrical capacity, but I know something of Oxford mathematical teaching. Speaking for myself, the fascinating lectures of the present Savilian Professor of Geometry will never cease to hold perhaps the most prominent place in my recollections of university work. It is quite true that I remember conversing with a college tutor who was rather doubtful about modern geometrical methods, and seemed disposed to look upon these lectures as "dangerous." He was a great stickler, however, for "legitimacy," thinking it wrong, for example, to import differential notation into analytical geometry; but I do not think he had a large following amongst younger Oxford men. I certainly did not find, in reading with some of them, that geometry was at all in disfavour. I have often had neat geometrical solutions pointed out to me of problems where other methods proved cumbrous or uninteresting; and conversely I have found geometrical short cuts were far from objected to. On the whole, the characteristic feature of the Oxford examination system (most marked in the Natural Science School, but making itself felt in all the others) being to encourage a student after reaching a certain point in general reading to make himself strong in some particular branch of his subject, I believe special attention to geometrical methods would pay very well.

Oct. 13 W. T. THISELTON DYER

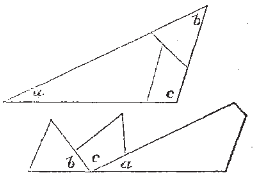
### Elementary Geometry

YOUR correspondent, "A Father," has in view a very desirable object—to teach a young child geometry—but I fear that he is likely to miss altogether the path by which it may be reached. His principle, that "a child must of necessity commit to memory much that he does not comprehend," appears to me to be totally erroneous, and not entitled to be called a fact. To this time-hallowed principle it is due that a large proportion of all who go to school learn nothing at all, while those more successful learn with little improvement of their faculties. It is a convenient principle which allows the title of teacher to be assumed by those who only hear lessons. Children labour under this difficulty that they learn only through language, which is to them a misty medium, particularly when the matter set before them is in any degree novel or abstruse, and no pains are taken to clear up the obscurity of new expressions. Children know nothing of abstraction, and learn to generalise from experience, not from words. Committing to memory what is not understood is a disagreeable task; begetting a hatred of learning, and causing many to believe that they want the special faculty required for the task set before them. The art of teaching the young ought to be the art of enabling them to comprehend, and memory ought to be strengthened not by drudgery but by being founded on understanding and by the rational connection of ideas.

Now geometry is the science of figure; it theorises reality, and the truth of every proposition in it may be made apparent to the senses. Double a piece of paper and cut out a triangle in duplicate. The two equal triangles thus formed, A and B, may be put together so as to form a parallelogram in three different ways. The child who makes this experiment will learn at once what is meant by a parallelogram, and he will perceive its properties, viz., that its opposite sides and angles are equal; that it is bisected by the diagonal, &c. But if he learns all this by rote, he acquires only a cloud of words, on which his mind never dwells. Propositions touching abstractions and generalisations can never be understood by the young without abundant illustration. When a geometrical truth is made apparent to the senses, when seen as a fact and fully understood, the language in which it is expressed having no longer a dim and flickering light, is easily learned and remembered, and the learner listens with pleasure to the discussion of the why and wherefore.

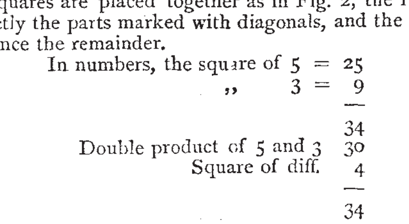


It is not enough for a child to learn by rote the definition of an angle. He ought to be shown how it is measured by a circle; and by circles of different sizes. In short, he ought to be taught what words alone will not teach him, that an angle is only the divergence of two lines. Let us now come to the important theorem that the three angles of any triangle are equal to two right angles (Euclid i. 32). Cut a paper triangle, mark the angles, then separate them by dividing the triangle and place the three angles together. They will lie together, filling one side of a right line, and thus be equal to two right angles. Let the learner test the theorem with triangles of every possible shape to convince himself of its generality, and then, fully understanding what it means, he will also understand the language in which it is proved.



It is a mistake to decry the use of symbols. They enable us to get rid of the wilderness of words, which form a great impediment in mathematical reasoning. Ordinary language can never group complex relations for comparison so compactly as to bring them within the grasp of the understanding. When we would compare objects, we place them close together, side by side. But the features and lineaments of objects described in language are too widely scattered to be kept steadily in view. It is easier to learn the use of symbols than to commit to memory what is not understood. Those who would learn mathematics without symbols can advance but a little way.

Neither is there any good reason for rejecting the second book of Euclid, though it certainly may be much abridged. The relations of whole and parts, sum and difference are easily exhibited, and an acquaintance with them is of great value to arithmeticians. Let us take for example the following propositions: "The squares (A and B) of any two lines (or numbers) are equal to double the rectangle under those lines (R and R, or the product in case of numbers) and the square of their difference D."



Now these figures being constructed, it will be found that when the two squares are placed together as in Fig. 2, the rectangles cover exactly the parts marked with diagonals, and the square of the difference the remainder.

In numbers, the square of 5 = 25
,, 3 = 9
—
34
Double product of 5 and 3 30
Square of diff. 4
—
34

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